

***Aenictus yangi* sp. n. – a new species of the *A. ceylonicus* species group (Hymenoptera, Formicidae, Dorylinae) from Yunnan, China**

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Abstract

In this study we present a taxonomic update for the *Aenictus ceylonicus* group. A recent survey of the leaf litter ant fauna of Xingshuangbanna (Yunnan, China) yielded material of a hitherto unknown member of the group, which we describe here as *Aenictus yangi* **sp. n.** The new species is clearly distinguishable from the other species of the *A. ceylonicus* group based on differences in mandibular dentition, the development of the metanotal groove, the shape of the propodeum and subpetiolar process, as well as surface sculpture on the mesosoma and waist segments. In order to integrate *A. yangi* **sp. n.** into the taxonomic system created by Jaitrong and Yamane (2013) we provide an update to the identification key provided in the latter revision, as well as a diagnostic discussion and high-quality illustrations of important species and morphological characters.

Keywords

Army ants, *A. ceylonicus* species group, China, taxonomy, Yunnan

Introduction

The ant genus *Aenictus* Shuckard, 1840 is widely distributed throughout the tropics and subtropics of the Old World. *Aenictus* species can be found from the Mediterranean and most of Africa through the Middle East to the Oriental, Indo-Australian, and Australasian regions, whereas they are completely absent in the New World, Madagascar, most of the Palaearctic, and the Pacific east of New Guinea (e.g. Wilson 1964; Gotwald 1995; Shattuck 2008). Currently, there are 180 valid species of *Aenictus* (Bolton, 2014) rendering it one of the larger genera among ants. Historically, the systematic placement of *Aenictus* was a question of debate with most authors treating it as a genus within the subfamily Dorylinae (e.g. Mayr 1865; Dalla Torre 1893; Emery 1895; Borgmeier 1954). In the last decades it was mostly considered as the only genus of the subfamily Aenictinae (Bolton 1990, 1995; Baroni Urbani et al. 1992) until the recent molecular phylogeny of Brady et al. (2014), which showed that *Aenictus* belongs to a monophyletic group containing all dorylomorph genera now placed in the subfamily Dorylinae.

All species of *Aenictus* are considered as “true army ants” (Wilson 1964), which means that they possess a combination of behavioural and reproductive traits defined as the “army ant syndrome” (Schneirla 1971; Gotwald 1995; Brady 2003). This syndrome includes obligate group foraging, nomadism, highly modified (dichthadiiform) queens, and establishment of new colonies through colony fission. Based on the available data, most *Aenictus* seem to be specialised predators of other ants, social wasps, and termites, but there are also reports of some species preying on non-social insects or, more rarely, gathering honeydew (Arnold 1915; Santschi 1933; Gotwald 1995; Shattuck 2008; Staab 2014). Shattuck (2008) noted that despite being widespread the genus is comparatively rarely collected. Nevertheless, all known species nest and usually perform their mass raids in the soil stratum, and only occasionally above ground, which might account for the relative uncommonness.

With the exception of the Afrotropical region, the taxonomy of *Aenictus* is in a relatively good state compared to other dorylomorph genera. The first modern, comprehensive taxonomic treatment was that of Wilson (1964) who revised the army ants of the Indo-Australian region. In the decades since taxonomic contributions consisted mainly of single species descriptions or small regional treatments (e.g. Terayama and Yamane 1984, 1989; Xu 1994; Wu and Wang 1995; Zhou and Chen 1999; Yamane and Hashimoto 1999; Wang 2006). Fortunately, in the last decade there were several contributions aiming to treat broader regions and to improve the subgeneric classification. Aktaş et al. (2004) provided the first taxonomic overview of the southwestern Palaearctic, Sharaf et al. (2012) treated the Middle East, and Shattuck (2008) revised the Australian *Aenictus* fauna. Concerning the South East Asian species, there were numerous recent contributions. Initially focusing on particular species assemblages and describing few additional species (e.g. Jaitrong and Eguchi 2010; Jaitrong and Yamane 2010; Jaitrong et al. 2010), the situation changed significantly with the diagnoses and definitions of species groups presented by Jaitrong and Yamane (2011). The latter publication provided workable hypotheses for twelve species groups with an easy-to-use identification key to the established

groups, as well as revisions for two species groups (*A. currax* and *A. laeviceps* groups). More recently Wiwatwitaya and Jaitrong (2011) revised the *A. hottai* group, Jaitrong and Hashimoto (2012) the *Aenictus minutulus* group, and Jaitrong and Yamane (2012) treated the *Aenictus javanus* and *Aenictus philippinensis* groups. Finally, Jaitrong and Yamane (2013) revised the *A. ceylonicus* group, which is the largest group known so far.

As already outlined in detail by Wilson (1964), there are two taxonomic systems for *Aenictus*, as well as for other army ants: one based on workers and one on males. The males of *Aenictus* are relatively large and often encountered in light traps, whereas they are seldom collected together with workers (Wilson 1964). So, the main problem is the lack of association between both systems. Wilson (1964) suggested ignoring the male-based names and establishing a sound worker-based taxonomy until males are found together with workers and the different taxonomic names can be harmonised. Jaitrong and Yamane (2011, 2013) concur with that approach and state that male-based names will eventually be matched with worker-based names using DNA information.

In this study we describe a new *Aenictus* species from the *A. ceylonicus* species group. The material was collected in Xingshuangbanna, Yunnan, China, during a recent survey of the local myrmecofauna (Guenard et al. 2013, Liu et al. in review). Despite being clearly a member of the *A. ceylonicus* group, our detailed morphological analysis did not allow us to fit it to any of the described group members. In addition, the material did not key out with the recent identification key provided by Jaitrong and Yamane (2013) in their revision of the *A. ceylonicus* group. Consequently, we consider the material as new and describe it herein as *A. yangi* sp. n. on the basis of the worker caste. We also integrate it into the taxonomic system created by Jaitrong and Yamane (2011, 2013) by updating their key to species of the *A. ceylonicus* group and providing a diagnostic discussion and high-quality illustrations of important species and morphological characters.

Abbreviations of depositories

The collection abbreviations follow Evenhuis (2014) and Jaitrong and Yamane (2013). The material upon which this study is based is located and/or was examined at the following institutions:

BMNH	The Natural History Museum, London, U.K.
CAS	California Academy of Sciences, San Francisco, U.S.A.
ISAS	Kunming, Kunming Institute of Zoology, Yunnan, China
HLMD	Hessisches Landesmuseum Darmstadt, Darmstadt, Germany
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.
MHNG	Muséum d'Histoire Naturelle de la Ville de Genève, Geneva, Switzerland
NHMB	Naturhistorisches Museum, Basel, Switzerland
PUPAC	Punjabi University Patiala Ant Collection, Patiala, India
SKYC	SKY Collection at Kagoshima University, Japan
THNHM	Natural History Museum of the National Science Museum, Thailand

Material and methods

The material used for this study was collected during an inventory of the ant fauna of Xingshuangbanna, Yunnan, China, in 2013, which yielded approximately 240 species/morphospecies (Liu et al. in review). The main focus of that study was to assess the ground and leaf litter ant fauna, and the new *Aenictus* species treated here was also collected from two leaf litter samples. All available workers were mounted, analysed, and measured. Morphological observations and measurements were done with a Leica M165 C stereomicroscope equipped with an orthogonal pair of micrometres at a magnification of 100×. Measurements were recorded in mm to three decimal places and rounded to two decimal places for presentation. The measurements and indices used in this study follow Jaitrong and Yamane (2011, 2013):

- CI** Cephalic index: $HW / HL \times 100$.
- HL** Maximum head length in full-face view, measured from the anterior clypeal margin to the midpoint of a line drawn across the posterior margin of the head. [Note: the anterior clypeal margin in species on the *A. ceylonicus* group is sometimes concave, which is the case in *A. yangi*, and measuring as defined above reduces the maximum head length].
- HW** Maximum head width in full-face view.
- ML** Mesosomal length measured from the point at which the pronotum meets the cervical shield to the posterior margin of metapleuron in profile.
- PL** Petiole length measured from the anterior margin of the peduncle to the posterior-most point of the tergite.
- SI** Scape index: $SL / HW \times 100$.
- SL** Scape length, excluding the basal constriction and condylar bulb.
- TL** Total length, roughly measured from the anterior margin of head to the tip of the gaster in stretched-out specimens.

In general, the morphological terminology used in this study follows Hölldobler and Wilson (1990), Bolton (1994), and for key characters of the genus *Aenictus* Jaitrong and Yamane (2011).

Results

The *Aenictus ceylonicus* species group

Diagnosis. The group was first diagnosed by Wilson (1964) and recently redefined by Jaitrong and Yamane (2011, 2013). The following definition is taken from the latter studies:

Antenna ten-segmented; with head in full-face view scape extending beyond half of head length, but not reaching the occipital corner of head; mandible linear, its basal

and external margins almost parallel; masticatory margin with large apical tooth followed by medium-sized subapical tooth, 0–6 small denticles present between subapical tooth and basal tooth; with mandibles closed, a gap present between mandibles and anterior margin of clypeus; anterior clypeal margin weakly concave or almost straight, lacking denticles; frontal carina short and thin reaching to or slightly extending beyond the level of posterior margin of torulus; with head in full-face view curved anterior extension of frontal carina reaching to or extending beyond the level of anterior clypeal margin; parafrontal ridges absent; promesonotum usually convex dorsally and sloping gradually to propodeum (rarely with almost straight dorsal outline); subpetiolar process developed. Head and first gastral tergite smooth and shiny. Body yellowish, reddish or dark brown; typhlatta spot absent.

Notes. The *A. ceylonicus* group under the above definition contains 33 species (Jaitrong and Yamane 2013) and is clearly the most species-rich group in the genus. It is widespread in the southeastern Palaearctic, Oriental, Indo-Australian and Austral-Asian regions (Wilson 1964; Shattuck 2008; Jaitrong and Yamane 2011, 2013). Its distinction from other groups is very straightforward on the basis of the linear mandible, the distinct gap between the mandibles and the anterior margin of the clypeus when the mandibles are closed, the almost straight or feebly concave anterior clypeal margin, and the lack of clypeal denticles. Some or most of the African *Aenictus* might be members of the group also (Wilson 1964), but due to the lack of revisions or other modern taxonomic treatment their affinities remain unclear.

Update to the identification key of the *A. ceylonicus* group

The identification key to the South East Asian species provided by Jaitrong and Yamane (2013) contains 22 key couplets for 23 species. The new species described here needs to be included, thus in the following we slightly modify the first few key couplets without altering the remainder of the key.

- | | | |
|----|--|------------------------|
| 1 | Mandibles with 2–6 teeth/denticles between subapical and basal teeth (mandibles with more than 4 teeth/denticles in total) (Fig. 4D)..... | 2 |
| – | Mandibles with 0–1 tooth/denticle between subapical and basal teeth (mandibles with 3–4 teeth/denticles in total) (Fig. 1A, B)..... | 15 |
| 2a | Dorsal face of propodeum mostly smooth and shiny; lateral face of propodeum partly smooth and shiny (Fig. 2A); postpetiole usually entirely smooth and shiny, rarely reticulate-punctate basally | 2b |
| – | Propodeum entirely sculptured (Fig. 2B); postpetiole entirely sculptured or with smooth and shiny small area on dorsal face | 6 |
| 2b | Metanotal groove noticeably present but weak; propodeal junction noticeably angulate with distinct tooth; subpetiolar process relatively elongate, subrectangular, and slightly projecting anteroventrally (Fig. 3A) | <i>A. yangi</i> |
| – | Character combination never as above; metanotal groove usually absent or strongly reduced, but always weaker than above; propodeal junction rounded | |

to angulate without/with small tooth; subpetiolar process variable, ranging from strongly reduced and rounded to subrectangular, but never as elongate as above (Fig. 3B–E) 3

From couplet 3 onwards there are no changes to the key presented by Jaitrong and Yamane (2013) and we refer to that publication.

***Aenictus yangi* sp. n.**

<http://zoobank.org/EF119658-0F74-48A9-8E5A-0CD76CF97143>

Figs 3A, 4A–D

Type material. Holotype, pinned worker, China, Yunnan, Xishuangbanna, Man Sai village, 21°51'34.4"N, 101°16'39.6"E, 680m, young rain forest, leaf litter, 12.IV.2013 (*B. Blanchard, B. Guénard & C. Liu*) (ISAS: CASENT0735503).

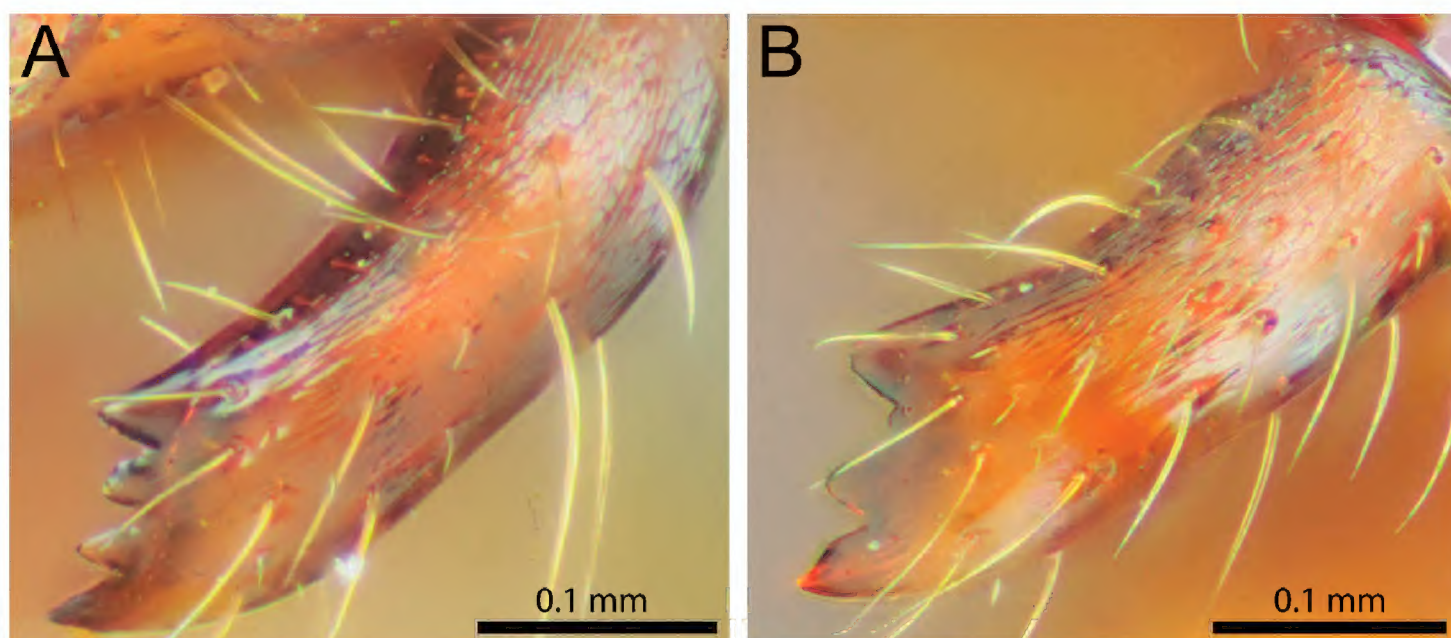


Figure 1. Mandible showing masticatory margin. **A** *A. maneerati* Jaitrong & Yamane **B** *A. watanasiti* Jaitrong & Yamane. Images are from Jaitrong and Yamane (2013).

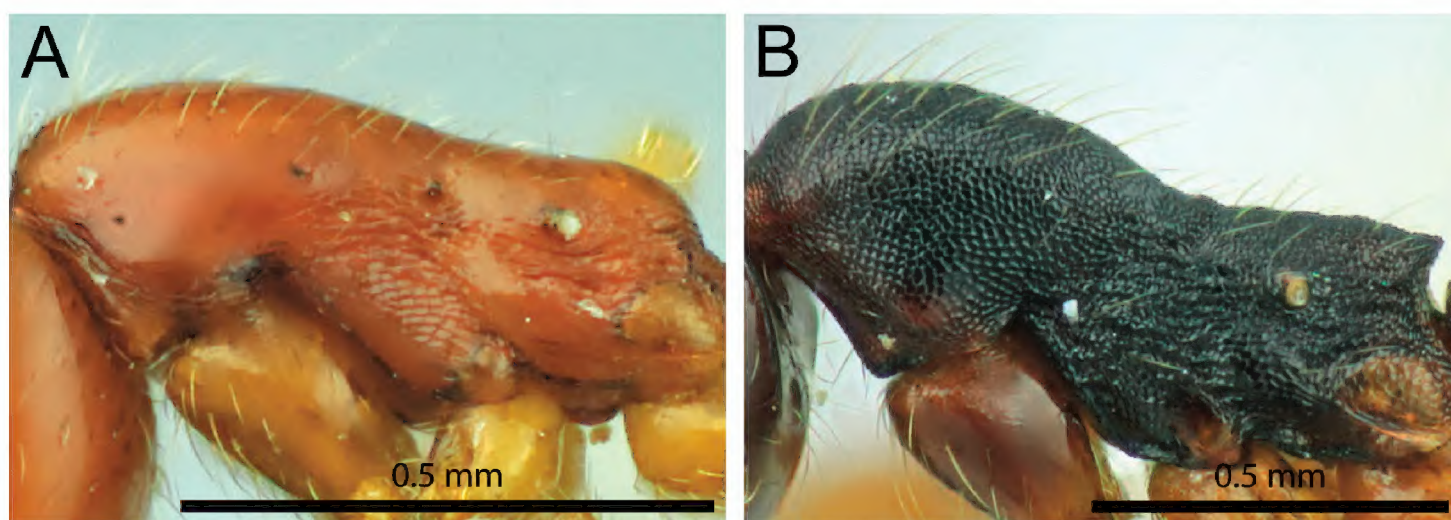


Figure 2. Mesosoma in profile. **A** *A. longicephalus* Jaitrong & Yamane **B** *A. pinkaewi* Jaitrong & Yamane. Images are from Jaitrong and Yamane (2013).

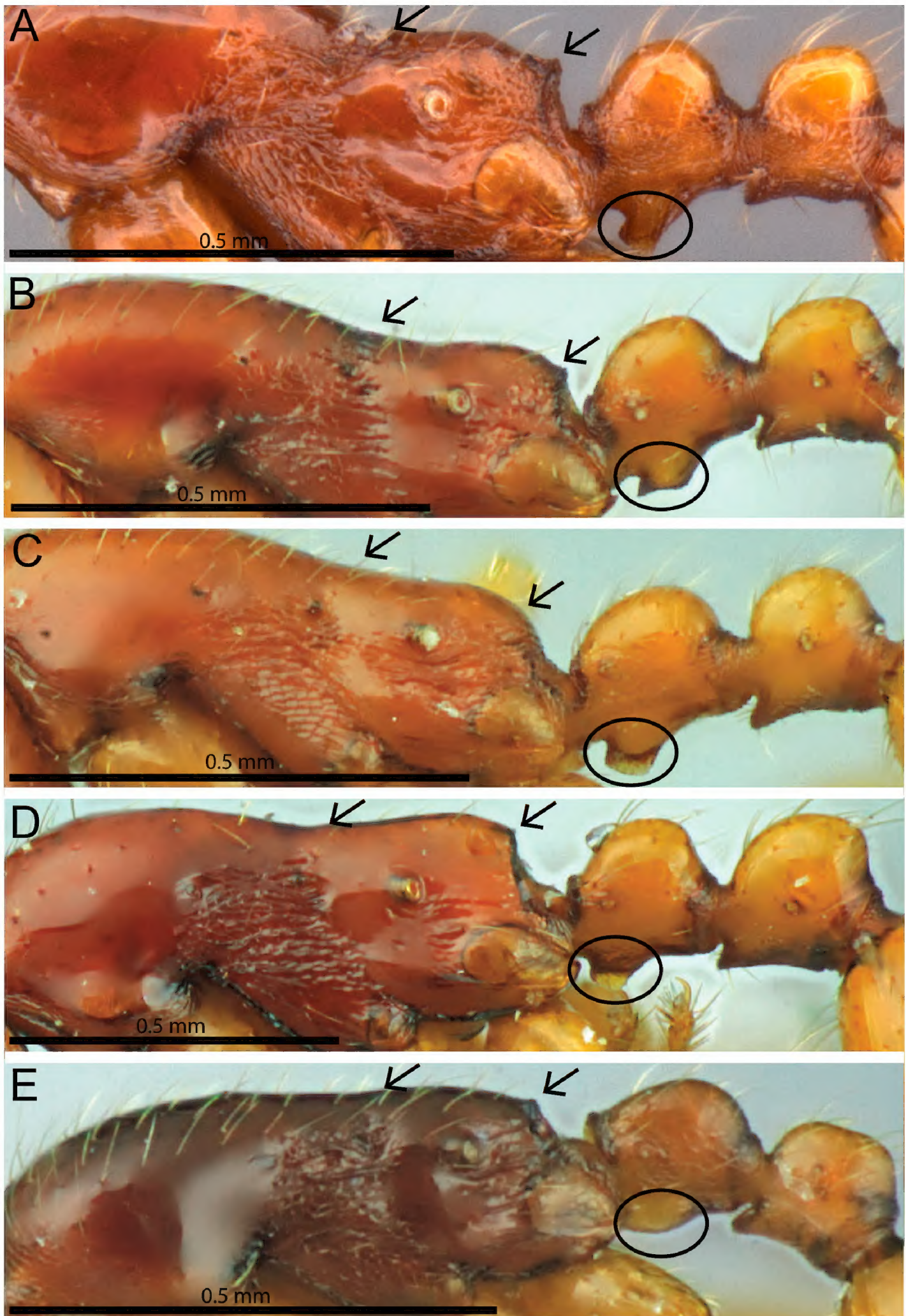


Figure 3. Mesosoma and waist segments in profile (black arrows indicate metanotal groove and propodeal junction, black ellipse subpetiolar process). **A** *A. yangi* sp. n. **B** *A. baliensis* Jaitrong & Yamane **C** *A. longicephalus* Jaitrong & Yamane **D** *A. minipetiolus* Jaitrong & Yamane **E** *A. wiwatwitayai* Jaitrong & Yamane. Images except figure 3A are from Jaitrong and Yamane (2013).

Paratypes, 14 pinned workers, China, Yunnan, Xishuangbanna, Man Sai village, 21°51'34.4"N, 101°16'39.6"E, 680m, young rain forest, leaf litter, 12.IV.2013 (*B. Blanchard, B. Guénard & C. Liu*) (BMNH: CASENT0717204; CAS: CASENT0735506; CASENT0735508; HLMD: CASENT0735507; ISAS: CASENT0717203; CASENT0735495; CASENT0735496; CASENT0735498; MCZ: CASENT0735505; MHNG: CASENT0735504; NHMB: CASENT0735501; PUPAC: CASENT0735500; SKYC: CASENT0735499; THNHM: CASENT0735497).

Non-type material. China, Yunnan, Xishuangbanna, Man Sai village, 21°51'34.4"N, 101°16'39.6"E, 680m, young rain forest, leaf litter, 12.IV.2013 (*B. Blanchard, B. Guénard & C. Liu*).

Diagnosis. *Aenictus yangi* differs from other South East Asian members of the *A. ceylonicus* group by the following combination of characters: head in full-face view distinctly longer than broad (CI 82–90); masticatory margin of mandible with seven teeth/denticles; antennal scapes relatively long (SI 76–86); metanotal groove noticeably present but weak; propodeal junction noticeably angulate with distinct tooth; subpetiolar process relatively elongate, subrectangular, and slightly projecting anteroventrally; propodeum laterally mostly smooth and shiny, weakly irregularly rugulose at base, and weakly reticulate-punctate near propodeal junction; petiole and postpetiole mostly smooth and shiny with lower portions reticulate-punctate.

Worker measurements (N=17). TL 2.21–2.60; HL 0.51–0.57; HW 0.43–0.50; SL 0.33–0.42; ML 0.69–0.87; PL 0.17–0.20; CI 82–90; SI 76–86.

Worker description. Head in full-face view distinctly longer than broad (CI 82–90), sides convex, posterior head margin straight to very weakly convex; occipital margin bearing a distinct carina. Antennal scapes relatively long (SI 76–86), extending beyond 2/3 of head length but not reaching posterior head margin. Frontal carinae relatively short and indistinct, reaching the level of posterior margin of torulus. Parafrontal ridges absent. Anterior clypeal margin weakly to moderately concave, not concealed by curved anterior extension of frontal carina. Masticatory margin of mandible with large acute apical tooth followed by one medium-sized subapical tooth, one small denticle, one medium-sized tooth, two smaller denticles, and medium-sized basal tooth, reaching total of seven teeth/denticles; basal margin straight. Maximum width of gap between anterior clypeal margin and mandibles about 1.0 to 1.4 times broader than maximum width of mandible. Promesonotum convex dorsally and sloping gradually to metanotal groove; metanotal groove noticeably present but weak; mesopleuron relatively long, clearly demarcated from metapleuron by weak groove; metapleural gland bulla relatively large, its maximum diameter about 1.7 to 2.1 times longer than distance between propodeal spiracle and metapleural gland bulla. Propodeum in profile with feebly convex dorsal outline; propodeal junction noticeably angulate with distinct tooth; declivity of propodeum moderately concave and encircled by strongly developed rim. Petiole in profile higher than long, its dorsal outline strongly convex; subpetiolar process relatively elongate, subrectangular, and slightly projecting anteroventrally. Postpetiole slightly smaller than petiole, its dorsal outline strongly convex. Head including antennal scape entirely

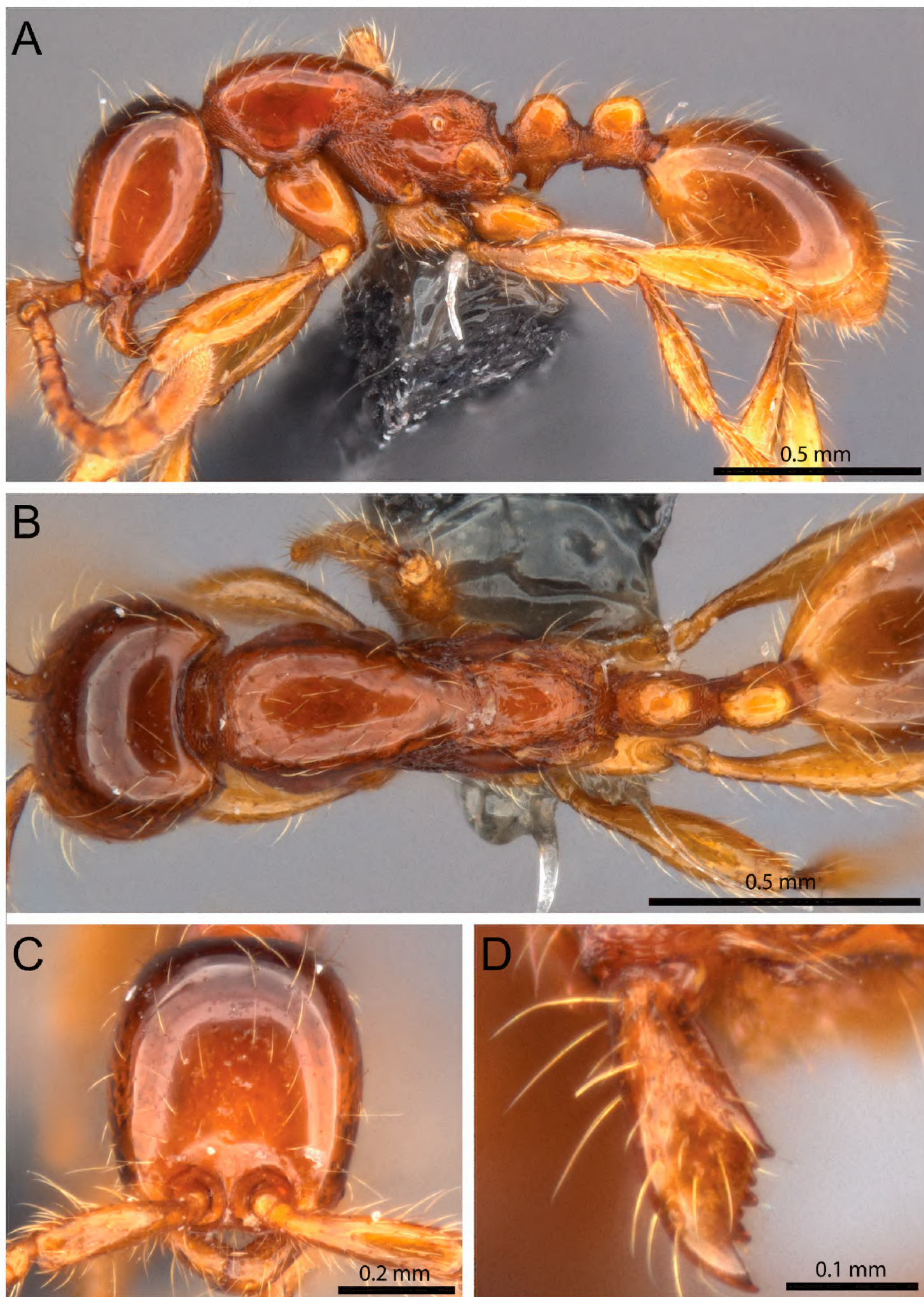


Figure 4. *Aenictus yangi* sp. n. (CASENT0735503). **A** Body in profile **B** Body in dorsal view **C** head in full-face view **D** right mandible in frontal view.



Figure 5. Map of South East Asia showing the type locality of *A. yangi* sp. n. (black star), red indicates Yunnan Province, China.

smooth and shiny. Mandibles predominantly unsculptured, smooth and shiny with weak, superficial striation basally. Promesonotum entirely smooth and shiny; mesopleuron and metanotal groove irregularly rugulose; propodeum laterally mostly smooth and shiny, weakly irregularly rugulose at base, and weakly reticulate-punctate near propodeal junction. Petiolar node and postpetiole mostly smooth and shiny with lower portions reticulate-punctate. Head and mesosoma dorsally with abundant erect to subdecumbent hairs. Head, mesosoma, and gaster usually reddish brown, always distinctly darker than yellow to light yellowish brown mandibles, antennae, petiole, postpetiole, and legs.

Etymology. The new species is dedicated to Da-Rong Yang from the Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences. We want to thank him for his great support of the first author's studies in the area.

Distribution and ecology. At present, the new species is only known from Xishuangbanna in southern Yunnan. The type locality is a tropical lowland rainforest situ-

ated at an elevation of around 550 m. The new species was only collected twice, both times through leaf litter extraction. Nevertheless, as for most *Aenictus*, we strongly suspect that *A. yangi* has a more hypogaeic lifestyle and might be more abundant in the soil stratum. The use of specific collection techniques that target subterranean army ants, such as subterranean oil baiting (Weissflog et al. 2001), will likely yield additional material of this species. Unfortunately, due to the limited available material there is no additional information about its ecology.

Taxonomic notes. The identification of *A. yangi* within the *A. ceylonicus* species group can be easily performed with the updated identification key provided above. The new species is morphologically most similar to *A. baliensis* Jaitrong & Yamane, 2013 (Bali), *A. longicephalus* Jaitrong & Yamane, 2013 (Lombok), *A. minipetiolus* Jaitrong & Yamane, 2013 (Lombok), and *A. wiwatwitayai* Jaitrong & Yamane, 2013 (Thailand). However, *A. yangi* can be immediately separated from these by the development of the metanotal groove, the shape of the propodeum and the subpetiolar process, and the sculpture on the mesosoma and waist segments (see Fig. 3 for details). *Aenictus yangi* can be easily separated from *A. brevipodus* Jaitrong & Yamane, 2013 (Thailand), and *A. formosensis* Forel, 1913 (Taiwan) by the number of mandibular teeth, shape of the head, the shape and punctate of petiole and postpetiole, and the shape of subpetiolar process.

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